Dietary education and iron deficiency anaemia in the inner city

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Abstract

Objectives—To assess if a dietary health education programme could be used within existing health resources to reduce the incidence of iron deficiency anaemia in an inner city population.

Design—Prospective cohort study.

Setting—Inner city areas of west and south Birmingham.

Subjects—A total of 1000 children recorded on the child health computer register.

Intervention—Children were recruited at birth and randomised into control and intervention groups. Families in the intervention group received specific health education information at key ages by face to face contact using a range of materials. The control group received standard health education as delivered by the health visitors at the time.

Main outcome measures—Haemoglobin estimation and iron content of the diet at 18 months of age.

Results—A total of 455 children completed the study. Sixty nine (27%) of the control group and 55 (28%) of the intervention group were anaemic as defined by haemoglobin less than 110 g/l. There was no difference in the iron content of the diets offered to the two groups of children.

Conclusion—In this deprived population we have shown no reduction in anaemia using a targeted nutritional programme and have highlighted the difficulties in conducting health education programmes within the scope of current health resources.

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Keywords: iron deficiency anaemia; primary preventative measures; health education.

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Iron deficiency is an important public health issue for children as it is the most common nutritional disorder in early childhood. The prevalence of iron deficiency anaemia in preschool children has been estimated as between 10 and 30%.[1–4] It is more common in children from some ethnic minority groups (notably Asian and African Caribbean) and children disadvantaged by poor socioeconomic circumstances.

The effects of iron deficiency in children under 5 years have been widely reported. Effects on psychomotor development are well recognised[1 5–7] and there is evidence that these adverse consequences may not be fully reversible with treatment.[8] This may be linked with a critical point in early childhood where lack of iron may have a permanent deleterious effect.[9]

The natural history of iron deficiency anaemia in young children is still not clearly delineated, but its high prevalence and its relationship with adverse developmental outcome suggests that primary preventative measures need to be emphasised, rather than secondary prevention (screening programmes). Previous studies have shown that health education programmes (when combined with screening) can have some success in primary care.[10] Our study attempted to determine whether a nutritional education programme using existing health care resources (with health visitors as the educators) could effectively reduce the prevalence of iron deficiency anaemia in inner city toddlers.

Subjects and methods

SUBJECTS

The study group was drawn from two inner city areas of west and south Birmingham, both areas of high socioeconomic deprivation. A small pilot sample was taken before the study started to assess the prevalence of anaemia in the toddler population of the areas. Twenty five of 73 (34%) children of a sample group aged between 18 and 24 months were shown to have haemoglobin <110 g/l.

Newborn infants were identified with the use of the child health computer child register. A total of 1000 infants was recruited at 6 weeks of age after interviews with the parent(s) had been carried out by the project health visitor. Informed written consent was obtained from the parent(s). Information was collected on socioeconomic factors and birth and family details. Children were randomised into control and intervention groups. Approval for the study was granted by the ethical committees of Central and West Birmingham Health Authorities.

METHODS

The control group received from their own health visitors the districts' current practice on nutritional education. There was no uniformity in nutritional education at the time of the study and this varied in consistency and with individual practice between districts. Interviews were carried out at around 3, 6, and 9 months of age, when data were collected on feeding practices.

The parent(s) of the children in the intervention group received additional specific information at these contacts. They listened to

Table 1   Characteristics of children in study

	No (%) recruited (n=1000)	No (%) completing project (n=455)
Ethnic group		
White European	186 (19)	50 (11)
Asian	712 (71)	357 (78)
African Caribbean	76 (8)	30 (7)
Other	26 (3)	18 (4)
Mother's education		
None or primary school only	310 (31)	160 (35)
Mother's age (years)		
< 20	280 (28)	82 (18)
> 38	240 (24)	26 (6)
Father's occupation by social class		
I and II	100 (10)	48 (11)
IV, V, or unclassified	500 (50)	276 (61)
Family size		
Average No of children	2.5	2.5
More than 3 children	220 (22)	104 (23)

audio tapes in relevant languages with the health visitor; they then had the opportunity and were encouraged to discuss the specific information on diet and iron at the time of the interview (with an interpreter if needed) and were given culturally appropriate health education leaflets. This additional information was aimed at three specific age groups: 3–4 months, 4–6 months, and 9–12 months. Its theme was to promote the correct use of breast milk or fortified infant feeds throughout the first year of life and to encourage good weaning diets containing an appropriate intake of iron rich foods and vitamin C.

A sample group of 20 families was visited during the study period to ensure that the health education materials had been received and understood appropriately.

At 18 months the children and parent(s) were seen for a final interview by the project health visitor; growth and dietary data were collected and a capillary blood sample was taken for a full blood count and serum ferritin measurement.

The families and general practitioners of all children completing the study were contacted with the blood test results. General practitioners were requested to treat anaemic children (as defined by haemoglobin <110 g/l) with a two month course of iron by mouth and measurements were repeated by the study team. Children with haemoglobin <80 g/l were referred to a paediatrician for evaluation. Children were excluded from the study if they were noted to be taking iron at the 18 month interview.

DIET AND FEEDING PRACTICES

Data on dietary practices were collected by 24 hour and seven day diet recall methods. These involved questionnaires on foodstuffs offered to the children. For 24 hour recall, data were collected on foods and drinks taken at mealtimes and other daytime 'snacks'. Data on seven day diet recall were obtained by listing specific foodstuffs. Parents/carers were then questioned on the regularity of consumption— for example, daily, three times weekly, once weekly, or not at all. On the basis of the diet recalled we calculated individual food scores from 1 to 7 with the consumption of foods in the following groups: (1) meat/fish; (2) eggs; (3) cereals/bread; (4) green vegetables; (5) len-

tils (dahl); (6) beans/non-green vegetables; and (7) fresh fruit/fruit juice.

The emphasis on determining a 'good' diet in terms of iron containing foods was based on the consumption of haem iron, foods containing non-haem iron and foodstuffs rich in vitamin C as an adjunct to iron absorption.

An adequate iron food score for data from 24 hour recall was defined as an intake of more than four of the foodstuff groups listed. For the seven day recall data an intake of more than four of the foodstuff groups at least three times in the week was classed as adequate.

The data were entered onto a database and analysed using Epi-Info.[11] The χ^2 test was used to analyse specified groups within the study.

Results

Although 1000 children were recruited, losses were high over the period of the study due particularly to population mobility and families not cooperating after initial recruitment. In addition, staff shortages and high health visitor caseloads limited the ability of the health visitors to sustain contact with non-attending families. A total of 455 children (45.5% of those recruited) completed the study fully.

Table 1 shows the characteristics of the study families recruited and completing the study. No difference between the control and intervention families was noted nor were there marked changes between those recruited and completing the study. In both groups >70% of the families were Asian. A large number of families were disadvantaged by maternal education status and environmental and social factors. Study losses were higher in those families who had younger and older mothers (<20 years and >38 years, respectively). A total of 22% of both groups had families of four or more children.

Table 2 shows the results of the blood tests. A full blood count (FBC) was measured on a capillary sample. Anaemia was defined as haemoglobin <110 g/l. Capillary blood was also taken for ferritin assay, but samples proved unsatisfactory for measuring iron status. The families of those children with haemoglobin <110 g/l were contacted for a repeat FBC after a request to their general practitioner to prescribe iron by mouth for two months. Repeat tests were obtained on 97 children (71%). An increase in haemoglobin of >10 g/l was noted in 55 children (57%), with a rise of >20 g/l in 26 (27%). Five children were identified as having blood indices suggestive of β thalassaemia trait and referred for further evaluation. Although compliance with treatment with iron by mouth was poor (<40% completed the course as requested), we feel the results reflect iron deficiency as the cause of anaemia.

The data show that 69 (27%) of the control and 55 (28%) of the intervention groups had haemoglobin <110 g/l. There was no significant difference between the two study groups (p = 0.9).

The prevalence of anaemia was higher in children of Asian and African Caribbean origin, reflecting observations from previous

Table 2   Children with anaemia (haemoglobin < 110 g/l); values are number (%) of children

	Control group (n=257)	Intervention group (n=198)	p Value
Total	69 (27)	55 (28)	0.9
Ethnic group			
White European	5 (19) [n=26]	3 (11) [n=27]	0.65
Asian	57 (27) [n=207]	46 (30) [n=152]	0.65
African Caribbean	5 (29) ([=17]	3 (25) [n=12]	0.87
Other	2 (28) [n=7]	3 (43) [n=7]	1.0
Total mean haemoglobin (g/l)	116	116	
Total mean MCV (fl)	69	70	

MCV = mean corpuscular volume.

Table 3   Anaemia and social variables (haemoglobin < 110 g/l)

	Control group (n=257)		Intervention group (n=198)		
	No (%)	Total	No (%)	Total	p Value
Mother's education					
None or primary school	31 (33)	93	23 (47)	68	0.95
More than primary school	36 (23)	159	32 (24)	130	0.79
No data	—	5	—	—	—
Social class					
I, II, and III	25 (28)	89	19 (22)	86	0.45
IV, V, and U	44 (26)	168	36 32)	112	0.34
Birth order					
Firstborn	22 (25)	89	17 (20)	83	0.63
Other rank	46 (27)	168	38 (33)	115	0.37

Table 4   Infant feeding practices; values are number (%) of children

	Control group (n=257)	Intervention group (n=198)
Breast feeding		
At 3 months	65 (23)	30 (15)
At 6 months	31 (12)	11 (6)
At 9 months	6 (2)	6 (3)
Introduction of pasteurised cows' milk		
At 3 months	20 (8)	9 (4)
At 6 months	100 (39)	123 (57)

Table 5   Dietary data; values are number (%) of children

	Control group (n=257)	Intervention group (n=198)	p Value
24 hour diet recall			
Food score > 4	88 (34)	75 (38)	0.48
7 day diet recall			
Food score > 4	209 (81)	161 (81)	0.9

Table 6   Twenty four hour diet data for social variables: food score > 4; values are number (%) of children

	Control group (n=257)	Intervention group (n=198)	p Value
Mother's education			
None or primary school	20 (21) [n=93]	17 (25) [n=68]	0.74
More than primary school	65 (40.8) [n=159]	58 (44.6) [n=130]	0.6
No data	— [n=5]	—	—
Social class			
I, II, and III	41 (46) [n=89]	34 (39) [n=86]	0.47
IV, V, and U	47 (28) [n=168]	41 (37) [n=112]	0.16
Birth order			
Firstborn	33 (37) (n=89)	35 (42) (n=83)	0.59
Other rank	55 (33) (n=168)	40 (34.7) (n=115)	0.81

reports.[2][4] There was no significant difference in the prevalence of anaemia between the control and intervention groups when children were matched for ethnicity and social variables (mother's education level, social class as identified by husband's or partner's occupation and birth rank) (table 3).

FEEDING PRACTICES
Data on feeding practices were collected at the 3, 6, and 9 month interviews. Table 4 gives the data for breast feeding practices and data on the age of introduction of fresh pasteurised

whole cows' milk for children completing the study. The proportion of children breast fed was low compared with current recorded UK practice. A total of 57% of children in the intervention group and 39% of those in the control group were recorded as taking fresh cows' milk at 6 months. This is despite advice contained in the additional health intervention material to continue breast feeding or to use fortified infant feeds, as well as standard advice given to parents of children in the control group by health professionals.

DIETARY DATA
Table 5 shows diet scores for 24 hour and seven day diet recall methods. There was no significant difference in the diets offered to the two groups. There is a poor correlation between the iron food scores recalled by the two methods; neither is sensitive as a predictor for anaemia (sensitivities 65 and 26%, respectively).

Twenty four hour diet recall has been used to match adequate food scores to social variables (table 6). As with the prevalence of anaemia, we noted no significant difference between the control and intervention groups. A significant difference was noted within groups when looking at maternal education, however. Children whose mothers had been educated beyond primary school level showed better food scores (p = 0.01 in the intervention group and p= 0.002 in the control group). This was not reflected by a significant difference in the level of anaemia (table 3).

GROWTH DATA
There were no differences in mean weight, height, or mid upper arm circumference at age 18 months between the control and intervention groups.

Discussion
The results of this study show that anaemia remains a common problem in inner city Birmingham and that the dietary health intervention methods used were ineffective in reducing its prevalence. 'Contamination' of the control group by cross filtering of the more specific health information delivered to the intervention group seems unlikely given the overall high prevalence of anaemia.

Despite the emphasis on good infant feeding practice, few mothers breast fed their infants beyond 3 months of age and significant numbers of infants received cows' milk before the age of 1 year. The level of fresh cows' milk intake is comparable with other UK reports of infants' liquid diets[12] and shows that this problem still needs to be addressed.

Twenty four hour dietary data suggest that the diets of the toddler population studied were poor in iron rich foods. The seven day dietary scores suggest a satisfactory dietary intake of iron, but inaccurate recall may bias these observations. This illustrates the difficulties in qualitative determinants of dietary intake and how this correlates with anaemia status. This is important because assessing satisfactory nutritional intake is often based on such methods.

The additional dietary educational measures were limited to the use of existing health visiting resources to deliver more targeted nutritional advice in three specific sessions. We acknowledge that this had no impact in reducing anaemia in this study population, who may be vulnerable because of the influences of cultural practices and disadvantage.

This project was not designed to determine the actual consumption of iron by quantitative assessment. We recognise that many factors influence the availability of iron in the diet and assessment is difficult. In addition, food fads and food refusal are common in this age and these influence the actual iron intake when compared with the diet offered. Feedback from the project health visitors showed this to be a common observation of parents/carers in both study groups. We were unable to determine how this may have influenced the results obtained, but this emphasises the need for further evaluation of the relationship between iron deficiency anaemia and qualitative and quantitative assessments of dietary iron intake.

Iron deficiency anaemia in early childhood may have deleterious consequences, many of which can be reversed with treatment; however, an adverse outcome for cognitive function may not be fully reversible. Such developmental effects may be more closely linked with the onset of anaemia in early life and the duration of anaemia.[9] More effective primary preventative measures are needed. The most effective means of preventing iron deficiency anaemia should be through dietary education, emphasising optimum feeding regimens and adequate weaning and toddler diets, with the use of fortified foodstuffs where appropriate (for instance, fortified infant feeds and cereals).

Effective public nutritional education programmes have been reported from the USA.[13 14] The most successful have included the free provision of fortified formula and foods.[15] A recent study in Birmingham has shown that the provision of a follow on formula milk was effective in preventing anaemia in children between 7 and 18 months of age[16] and shows that this approach could also be successful in the UK.

Much nutritional education is on an individual basis, as used in this study. Although other studies have reported success in raising immediate dietary awareness with such methods,[10] we found them to be ineffective in promoting changes in feeding practices in the families recruited. A follow up study of children screened for iron deficiency anaemia who received similar dietary advice has also questioned its longer term effectiveness.[17]

Many factors are important in the success or failure of such approaches. Health educators should understand iron nutrition and deficiency in young children, and the influence of differing cultural practices and economic constraints. They must acknowledge how the receipt and implementation of such information by individuals will be influenced by conflicting advice from other family members (particularly when these are the relevant care givers) and friends. We speculate that it might be more successful to focus on 'group' health education using community groups, local media, dietetic support, and more involvement from families themselves.

Key messages
- The prevalence of iron deficiency anaemia in young children is high, particularly those disadvantaged by poor socioeconomic circumstances and in children of certain ethnic groups
- Iron deficiency adversely effects children's cognitive development—this effect may not be fully reversible with treatment
- Standard nutritional educational packages were ineffective in reducing the level of anaemia in this study
- Community based approaches to prevention should be combined with secondary prevention by screening and treatment of populations at risk

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